PB80-217243

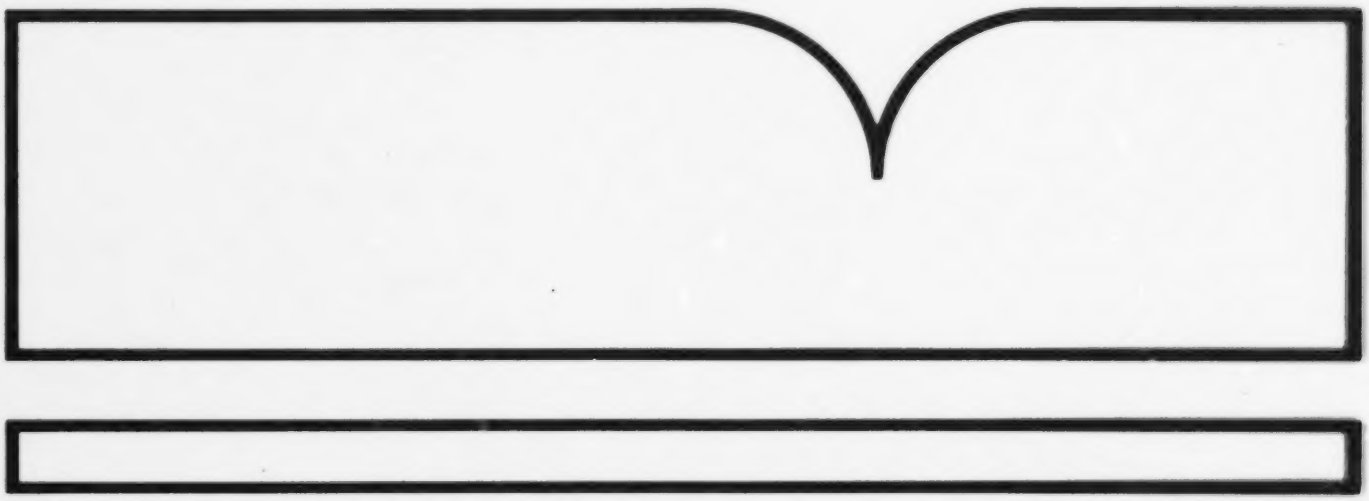
Asbestos-Containing Materials in School Buildings: Bulk Sample Analysis Quality Assurance Program

Research Triangle Inst.
Research Triangle Park, NC

Prepared for

Environmental Protection Agency
Washington, DC

Aug 80



U.S. Department of Commerce
National Technical Information Service
NTIS

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA 560/13-80-23	2.	3. RECIPIENT'S ACCESSION NO. PB 80 217243
4. TITLE AND SUBTITLE Asbestos-Containing Materials in School Buildings: Bulk Sample Analysis Quality Assurance Program		5. REPORT DATE August 1980 preparation date 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) E.P. Brantly, Jr. and D.E. Lentzen		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Research Triangle Institute P.O. Box 12194 Research Triangle Park, NC 27709		10. PROGRAM ELEMENT NO. 11. CONTRACT/GRANT NO. Contract No. 68-01-5848
12. SPONSORING AGENCY NAME AND ADDRESS Survey and Analysis Division Office of Pesticides and Toxic Substances U.S. Environmental Protection Agency Washington, DC 20460		13. TYPE OF REPORT AND PERIOD COVERED Final 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

EPA has initiated a quality assurance (QA) program for laboratories claiming capability in the polarized light microscope (PLM) analysis of bulk samples for asbestos. Commercial and non-commercial laboratories participating in the program received samples of four fibrous materials: chrysotile, anthophyllite, fiberglass, and mineral wool. Laboratories had difficulty identifying anthophyllite and two false positives were reported for the mineral wool sample. All laboratories properly identified chrysotile. A performance rating based on proper identification of positive(asbestos) and negative(non-asbestos) samples was scored for and reported to the commercial laboratories. Reference reports were sent to all participating laboratories. Continuation of the program with future sample sets is anticipated.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Asbestos Serpentine Amphiboles	Bulk Sample Analysis	

18. DISTRIBUTION STATEMENT Release to public	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES 32
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE

EPA Form 2220-1 (9-73)

United States
Environmental Protection
Agency

Office of
Toxic Substances
Washington DC 20460

EPA-560/13-80-23
August, 1980

PB80-217243

Toxic Substances

EPA

Asbestos-Containing Materials in School Buildings:

Bulk Sample Analysis Quality Assurance Program

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA 22161

EPA 560/13-80-23
August 1980

ASBESTOS-CONTAINING MATERIALS IN SCHOOL BUILDINGS: BULK SAMPLE ANALYSIS QUALITY ASSURANCE PROGRAM

By

E. P. Brantly, Jr., and D. E. Lentzen
Research Triangle Institute
Research Triangle Park
North Carolina 27709

Contract No. 68-01-5848

Task Manager: Cindy Stroup
Project Officer: Joseph Carra

Design and Development Branch
Survey and Analysis Division
Office of Pesticides and Toxic Substances
Environmental Protection Agency
Washington, DC 20460

Disclaimer

This document has been reviewed and approved for publication by the Office of Testing and Evaluation, Office of Pesticides and Toxic Substances, U.S. Environmental Protection Agency. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

CONTENTS

		Page
1.	Introduction	1
2.	Procedures	2
3.	Results	3
4.	Plans	4

Appendixes:

Appendix A:	Instructions and Reporting Form	5
Appendix B:	Reference Reports	9
Appendix C:	Reports to Laboratories	14
Appendix D:	Commercial Laboratories	16
Appendix E:	Laboratory Data	20

ASBESTOS-CONTAINING MATERIALS IN SCHOOL BUILDINGS: BULK SAMPLE ANALYSIS QUALITY ASSURANCE PROGRAM

1. INTRODUCTION

Growing public concern with the effects of exposure to asbestos fibers has resulted in a greatly increased demand for laboratory analyses to determine the content of bulk insulation samples. In the course of the Environmental Protection Agency asbestos-in-schools program, many differences have been noted in laboratory analytical services contracted for by public school systems. Discrepancies among laboratories may be attributed to variations in analytical methods, lack of appropriate reference standards, and inadequate reporting of analytical results.

Polarized light microscopy (PLM) is the EPA method of choice* for detecting asbestos in bulk insulation samples. To facilitate the public's contact with PLM service laboratories, a list of commercial laboratories claiming capability in PLM analysis was made available to EPA regional asbestos coordinators, state asbestos contacts, and to the public upon request via a toll-free number established to provide technical information on sampling and analysis of insulation materials.

A quality assurance (QA) program was initiated to qualify, to a limited extent, the services provided by the listed commercial laboratories. All laboratories listed were invited to participate in the QA program. Laboratories accepting were provided with four characterized samples and their analytical reports compared with reference analyses. This was not an accreditation program and did not seek to certify or endorse participating laboratories. A performance rating based on a fairly lenient criterion was determined for each laboratory and was included on the updated laboratory list. Laboratories had been notified at the start of the project that such a rating would be made. Participation in the program was required for laboratories to be included on the final published listing.

Noncommercial laboratories identified by EPA regional officials, including state health departments and universities, were offered the same samples

---

*Asbestos-containing materials in school buildings: A guidance document, EPA/OTS #C00090, March 1979.

and reporting forms. Participation by noncommercial laboratories was also voluntary and their results will not be available to the public.

2. PROCEDURES

2.1 Reporting Form and Instructions

Instructions and a reporting form developed for laboratory use in communicating analytical results are included as Appendix A. The form satisfies various information needs, including identity of asbestos and nonasbestos fibers, analytical method(s) used, quantitation procedures used, and quality control measures employed.

2.2 Selection and Distribution of Samples

Four bulk samples were sent to each laboratory. Two contained asbestos fibers, anthophyllite and chrysotile, and two were nonasbestos fiber material, mineral wool and fiberglass, commonly found in insulations. The samples were doublebagged, coded, and packaged with a reporting form and instructions for analysis. Sample packages were mailed on December 28, 1979, to all laboratories then on the listing.

2.3 Reference Reports

Analytical reports were obtained from two reference laboratories, Battelle Columbus Laboratories of Columbus, Ohio, and the Bureau of Mines, U.S. Department of the Interior, Avondale, Maryland. These are included as Appendix B. Reference report data were the basis for comparison in determining a laboratory's performance rating and were included on the reports to laboratories.

2.4 Quantitation

Estimates were provided by the laboratories of the relative amounts of sample constituents. These were averaged for each sample lot, disregarding errors in fiber identification. Means and standard deviations were included on reports to the laboratories. Because of the lack of an accepted quantitation procedure, values reported were not used in rating laboratory performance.

The distributions of quantitative estimates were recorded on histograms in 5 percent intervals. The histograms were included on individual reports to allow laboratories to place themselves within the distribution.

2.5 Reports to Laboratories

Reports were issued to individual laboratories on March 25, 1980 (commercial), and April 3, 1980 (noncommercial). Reports included the results of reference analyses, data reported by the individual laboratory, and summary data on quantitative estimates. An example of the reports to laboratories is included as Appendix C.

2.6 Performance Rating

Laboratory performance was assessed on the basis of correct identification of "positive" and "negative" samples. Reductions of the all-correct (4/4) score were made only for the reporting of false positives (nonasbestos sample reported as containing asbestos) or false negatives (no asbestos reported in an asbestos-containing sample), and not for the misidentification of individual asbestiform mineral species. The criterion, though lenient, recognizes the basic concern of the public--whether or not asbestos fibers are present in a submitted sample. Environmental Consulting and Testing Services and Princeton Testing Laboratories were assigned scores of 3/4. All other commercial laboratories scored 4/4.

3. RESULTS

Seventy-one percent of the laboratories contacted reported results, including 52 of 72 commercial labs and 23 of 34 noncommercial labs. Results included were received on or before January 25, 1980. Participating commercial laboratories are listed in Appendix D. A listing of reported results (fibrous materials only) is included as Appendix E.

For the 300 (75 × 4) samples analyzed, no false negatives and only two false positives were reported. Environmental Consulting and Testing Services of Cherry Hill, NJ, and Princeton Testing Laboratory of Princeton, NJ, incorrectly identified mineral wool as crocidolite and amosite, respectively. All other laboratories identified the sample as either mineral wool, fiberglass, or glass wool. Although the distinction between these materials is apparent to an experienced analyst, it was not deemed important to the present evaluation program.

Anthophyllite-asbestos was frequently misidentified as either amosite (15 labs) or tremolite (10 labs). This was most likely due to unfamiliarity with anthophyllite-asbestos because no standard reference samples exist and it is not commonly found in insulation materials. Closer attention to extinction

angles in analysis and use of the samples as a reference may alleviate this problem in future samples received for routine analysis.

Fiberglass was identified as fiberglass, mineral wool, or glass wool by all laboratories. Chrysotile was properly identified by all laboratories. However, laboratories are experienced in identifying chrysotile, as it is the most common asbestos fiber found in insulation materials.

4. PLANS

The second round of the continuing QA program will start in August 1980, and will also involve the distribution of samples and reporting of results of PLM analysis. The list of commercial laboratories will be updated with performance ratings and participating laboratories following each round. Subsequent rounds are anticipated quarterly. Future rounds will include samples of asbestiform and nonasbestiform minerals as well as samples of insulation materials removed from schools and private buildings across the country.

APPENDIX A
INSTRUCTIONS AND REPORTING FORM

ASBESTOS BULK SAMPLE ANALYSIS PROGRAM

Research Triangle Institute 800-334-8571, ext. 6746

INSTRUCTIONS:

1. Verify that this kit contains four bulk material samples containing varying amounts of asbestos fibers, nonasbestos fibers, and other materials. Unless the kit is incomplete or contains broken samples, fill out and return the enclosed post card.

2. If this kit is incomplete or contains broken samples:

   PHONE: 800-334-8571, ext. 6746
   ASK FOR: Gene Brantly
   Asbestos Bulk Sample Analysis Program
   Research Triangle Institute
   Research Triangle Park, NC 27709

3. Perform a complete analysis of each sample by polarized light microscopy, with or without dispersion staining.

4. Record the requested information on a copy of the Results Reporting Form. Final results of the analyses of all samples should be reported on one form.

5. Fill in all blocks for each analysis performed, using zeros where necessary. In categories offering numbered choices, write the correct number in the appropriate block, followed by a percent value or comment. All reported values should be expressed as percentages of the total material in each sample. Reporting forms with incomplete information will not be evaluated.

6. Include the laboratory identification number and sample identification numbers on all Results Reporting Forms. The space labelled "Sample Code Assigned by Laboratory" should be used for internal quality control programs involving split samples.

   Example Sample Labels: 2750-01-372
   2750-01-149
   2750-01-967
   2750-01-730

Laboratory ID# 2750				
Sample ID#	01-372	01-149	01-967	01-730

7. Complete the reverse side of the Results Reporting Form.

8. Retain all samples for reference following receipt of the program results and statistical summary.

9. Return the Results Reporting Form within 15 working days after receipt of the sample kit.

Late Returns Will Not Be Evaluated

RETURN REPORTING FORM
WITHIN FIFTEEN WORKING DAYS
AFTER RECEIVING SAMPLES.
LATE RETURNS WILL NOT BE EVALUATED.

Results Reporting Form

ASBESTOS BULK SAMPLE ANALYSIS PROGRAM

Laboratory I.D. #					
Sample I.D. #					
Sample Code Assigned by Laboratory					
Analytical Method (enter number)	1. PLM 2. PLM + dispersion staining 3. X-ray diffraction				
Gross Sample Appearance (enter number; note color)	1. Homogeneous, fibrous 2. Homogeneous, nonfibrous 3. Heterogeneous, fibrous 4. Heterogeneous, nonfibrous 5. Heterogeneous, mixed				
Sample Treatment (enter number)	1. Homogenized 2. Untreated 3. Other, *specify*				
Amount of Material Examined (mg)					
Asbestos Present (enter number and percent)	1. Amosite 2. Chrysotile 3. Crocidolite 4. Other, *specify*				
Percent Total Asbestos Present in Sample					
Other Fibrous Materials Present (enter number and percent)	1. Fiberglass 2. Mineral Wool 3. Cellulose 4. Other, *specify*				
Nonfibrous Materials Present (description and percent)					

(Continued: Please provide requested information on reverse side of this form.)

Description of Method of Quantitation

Description of Quality Control Program (e.g., #slides/sample, #splits/set)

Comments

Analyst: _____

Confirmation by: _____

Report Reviewed by: _____

Address Correction Please: _____

APPENDIX B
REFERENCE REPORTS

Battelle
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201
Telephone (614) 424-6424
Telex 24-5454

January 21, 1980

Mr. D. Lentzen
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, North Carolina 27711

Dear Mr. Lentzen:

The X-ray diffraction analyses of your four samples of insulation material have been completed, with the results given in Table 1. Only Sample 2 and Sample 4 produced diffraction patterns.

Sample 1 produced a single broad band between 3.6 Å and 2.5 Å with maximum intensity near 2.9 Å. Sample 3 produced a broader band from 4.9 Å to 2.5 Å with a broad maximum centered at 3.2 Å.

The diffraction patterns were taken using a Phillips vertical goniometer fitted with a sample spinner and diffracted beam monochromater. A Phillips standard focus Cu target X-ray tube was used to produce the incident beam. The samples were mounted for analysis using double sided adhesive tape. The sample spinner was used to reduce the effects of sample orientation.

The unused portion of your samples is enclosed. If you have any questions regarding these analyses, please call me at (614) 424-5301.

Sincerely,

P. M. Schumacher

P. M. Schumacher
Chemist
Physico-Chemical Systems

PMS/cln

Enclosure

TABLE 1

X-RAY DIFFRACTION OF ANALYSIS OF INSULATION MATERIAL

Sample	Compound	PDF#	Pattern Strength
#1	No diffraction peaks - see text		
#2	$Mg_3Si_4O_{10}(OH)_2$ (Talc)	13-558	Strong
	$(Mg, Fe)_7Si_8O_{22}(OH)_2$ (Anthophyllite)	9-455	Weak
#3	No diffraction peaks - see text		
#4	$Mg_3Si_2O_5(OH)_4$ (Clinochrysotile)	27-1276	Strong

United States Department of the Interior
BUREAU OF MINES
4900 LASALLE ROAD
AVONDALE, MARYLAND 20782

December 28, 1979

Dr. Donald Lentzen
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, N.C. 27709

Dear Don:

The five reference asbestos samples submitted on December 10 have been examined by optical microscopy and X-ray diffractometry for mineralogy and purity. The results of this examination are given below.

Sample 1: Mineral wool composes over 98% of the sample. Greater than 90% of the mineral wool fibers range from 5 to 10 μm in width. The minimum width is approximately 1 μm. Less than 5% of the particles are glass globules or blebs.

Sample 2: This is a relatively impure sample with as much nonasbestos material as asbestos. The major constituents in order of abundance are chlorite, talc, and anthophyllite. There are minor amounts of tremolite and serpentine also present. The anthophyllite is fibrous while the tremolite ranges from blocky to slightly elongate. The chlorite and talc appear as elongated plates, pseudomorphic after the amphiboles.

Sample 3: This sample is composed of greater than 98% fiberglass. Over 90% of the fiberglass is 7 to 20 μm in width with a minimum width of approximately 2 μm. Less than 5% of the particles are glass blebs or globules.

Sample 4: Chrysotile composes greater than 95% of the sample with 3% opaques, less than 1% platy minerals (possibly antigorite-lizardite) and less than 2% others.

Sample 5: (R-11) This sample is composed of over 95% tremolite asbestos with 2% to 4% carbonate. The tremolite is predominately fibrous with only a small percentage being blocky.

Best wishes for the New Year.

Sincerely yours,

Bill

William J. Campbell
Acting Research Director

APPENDIX C
REPORTS TO LABORATORIES

ASBESTOS BULK SAMPLE ANALYSIS PROGRAM
RESULTS OF ROUND 1

Laboratory:

Laboratory I.D. #:

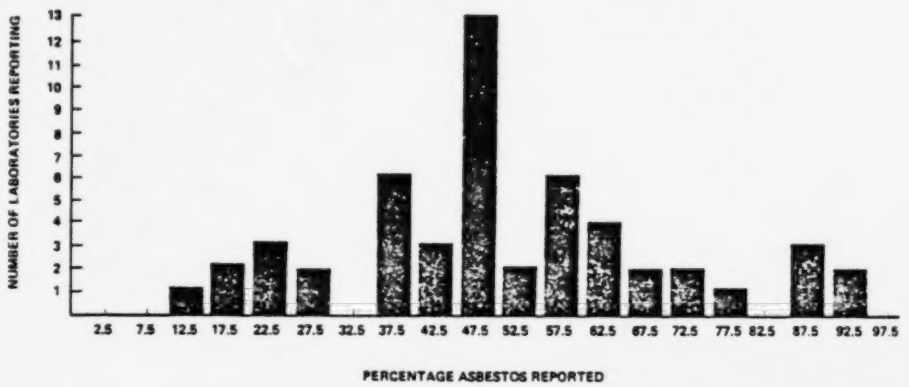
Sample I.D. #:	_____	_____	_____	_____
Asbestos Present (%)				
Laboratory report	0	75 anthophyllite	0	95 chrysotile
Reference report	0	53 anthophyllite	0	95 chrysotile
Other Fibrous Material (%)				
Laboratory report	100 mineral wool	0	95 fiberglass	0
Reference report	98 mineral wool	0	98 fiberglass	0

Summary of Laboratories Reporting:

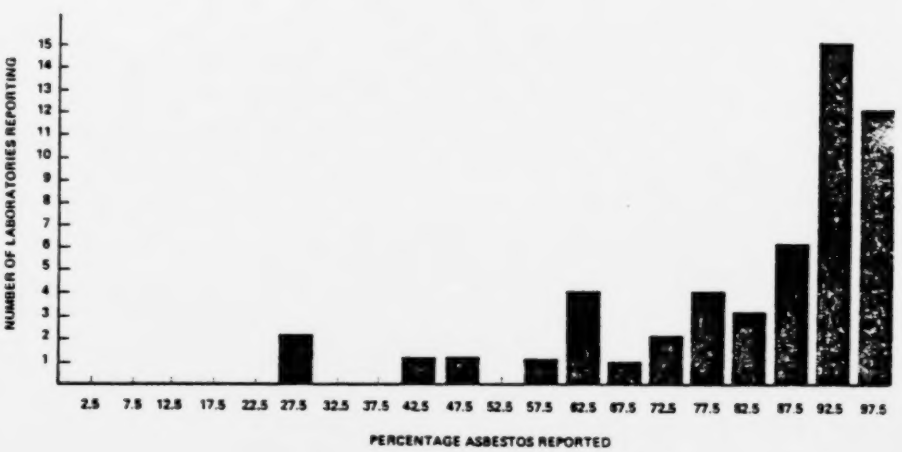
Mean % (Standard deviation)				
Asbestos present	0 (0)	53.0 (19.3)	0 (0)	84.5 (17.4)
Other fibrous material	96.1 (5.4)	1.4 (7.1)	97.7 (4.0)	1.2 (3.1)

Distribution of Asbestos Quantitation

Sample I.D. #: 801



Sample I.D. #: 854



APPENDIX D
COMMERCIAL LABORATORIES

American Can Company
Safety & Industrial Hygiene Laboratory
U.S. Highway 22
Union, New Jersey 07083

American Microscopy Laboratory
D. 3410 12th Avenue E.
Tuscaloosa, Alabama 35405

Analytical Center, Inc.
P. O. Box 15635
Houston, Texas 77020

Boeing Technology Services
9R-25
P. O. Box 3707
Seattle, Washington 98124

Brewer Analytical Laboratories
311 Pacific Street
Honolulu, Hawaii 96810

C.E.D., Inc.
Environmental Microscopy International
135 West Cutting Blvd.
Richmond, California 94804

Casalina Associates, Inc.
47-345 Mahakea Road
Kaneohe, Hawaii 96744

Certified Testing Laboratories, Inc.
2905 East Century Boulevard
South Gate, California 90280

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

Colorado School of Mines
Research Institute
P. O. Box 112
Golden, Colorado 80401

Fay Goldblatt
407 N. Butrick St.
Waukegan, Illinois 60085

Continental Technical Services
Environmental Health Division
9742 Skillman
Dallas, Texas 75243

Department of Chemistry
New Jersey Institute of Technology
323 High Street
Newark, New Jersey 07102

Department of Geological Sciences
SUNY, New Paltz
New Paltz, New York 12562

Department of Geology
Illinois State University
Normal, Illinois 61761

Eastern Analytical Laboratories
One "A" Street
Burlington, Massachusetts 01803

EMS Laboratories
12563 Crenshaw Boulevard
Hawthorne, California 90250

EMV Associates, Inc.
Microanalysis Laboratory
15825 Shady Grove Road
Rockville, Maryland 20850

Environment/One Corporation
2773 Balltown Road
Schenectady, New York 12301

Environmental Consulting & Testing Services
P. O. Box 3521
Cherry Hill, New Jersey 08034

Environmental Health Services, Inc.
5206 Lindbergh Blvd.
W. Carollton, Ohio 45449

Erie Testing Laboratories
2401 W. 26th Street
Erie, Pennsylvania 16506

Erlin, Hime Associates
811 Skokie Boulevard
Northbrook, Illinois 60062

GCA Corporation
Techology Division
Burlington Road
Bedford, Massachusetts 01730

Geoscience Consultants, Inc.
P. O. Box 341366
Coral Gables, Florida 33134

Hager Laboratories
12000 E. 47th Avenue
Denver, Colorado 80239

Health Science Associates
Suite B/C
10941 Bloomfield Street
Los Alamitos, California 90720

Herron Testing Laboratories
5405 Schaaf Road
Cleveland, Ohio 44131

IIT Research Institute
10 West 35th Street
Chicago, Illinois 60616

Industrial Analytical Laboratory
1523 Kalakaua Avenue
Suite 101
Honolulu, Hawaii 96826

Industrial Hygienics, Inc.
755 New York Avenue
Huntington, New York 11743

Industrial Testing Laboratories, Inc.
2350 Seventh Blvd.
St. Louis, Missouri 63104

Inter-City Testing & Consulting Corporation
P. O. Drawer "O"
609 Middle Neck Road
Great Neck, New York 11023

Interscience Research
2614 Wyoming Avenue
Norfolk, Virginia 23513

Jesse H. Bidanset & Associates, Inc.
P. O. Drawer "O"
609 Middle Neck Road
Great Neck, New York 11023

Law Engineering Testing Company
3301 Winton Road
Raleigh, North Carolina 27619

LFE Corporation
Environmental Analysis Lab Division
2030 Wright Avenue
Richmond, California 94804

Maryland Mineral Analysis Laboratory
Department of Geology
University of Maryland
College Park, Maryland 20740

MJH Associates
Mineralogical Consultants
13345 Foliage Avenue
Apple Valley, Minnesota 55124

Northrop Services, Inc.
P. O. Box 12313
Research Triangle Park, North Carolina 27709

PEDCo Environmental, Inc.
11499 Chester Road
Cincinnati, Ohio 45246

Princeton Testing Laboratory
P. O. Box 3108
Princeton, New Jersey 08540

R. J. Kuryvial & Associates
Mineralogy/Microscopy Consultants
12185 W. 29th Place
Lakewood, Colorado 80215

Southwestern Laboratories
P. O. Box 10687
Dallas, Texas 75207

St. Paul Fire & Marine
Environmental Services Analytical Laboratory
494 Metro Square Building
7th and Robert Streets
St. Paul, Minnesota 55101

Sunbelt Associates, Inc.
6961 Mayo Road
New Orleans, Louisiana 70126

Thomas A. Kubic & Associates
8 Pine Hill Court
Northport, New York 11768

Tri-State Laboratories, Inc.
54 Westchester Drive
Austintown, Ohio 44515

Truesdail Laboratories, Inc.
4101 N. Figueroa Street
Los Angeles, California 90065

United States Testing Company, Inc.
1415 Park Avenue
Hoboken, New Jersey 07030

Utah Biomedical Test Laboratory
520 Wakara Way
Salt Lake City, Utah 84108

Walter McCrone Associates, Inc.
2820 S. Michigan Avenue
Chicago, Illinois 60616

Wausau Insurance Companies
Environmental Health Laboratory
2000 Westwood Dr.
Wausau, Wisconsin 54401

APPENDIX E
LABORATORY DATA

CODING KEY FOR ABSAP PRINT-OUT

CO = commercial
NC = non-commercial
LAB = laboratory ID #
SAM = sample lot (1,2,3,4)
A1P + A2P = ALLP
O1P + O2P = OSUMP

Method (METH)
0 = no information
1 = PLM
2 = PLM with dispersion staining
3 = PLM, confirmed by XRD

Treatment (TRT)
1 = homogenized
2 = untreated
3 = acid wash
4 = ashed
5 = mortar and pestle
6 = particle picking
7 = rolled and quartered

Asbestos present (A1, A2)
1 = amosite
2 = chrysotile
3 = crocidolite
4 = anthophyllite
5 = actinolite
6 = tremolite
7 = "amphibole"
8 = "serpentine"

Other fibrous materials (O1, O2)
1 = fiberglass
2 = mineral wool
3 = vegetable fiber (cotton, cellulose, paper)
4 = synthetic fiber (nylon, rayon, etc.)
5 = glass wool
6 = fibrous talc
7 = wollastonite

LABORATORY VALUES

C_NC=CO SAMP1

OBS	LAB	METH	TRT	A1	A1P	A2	A2P	ALLP	O1	O1P	O2	O2P	OSUMP
1		2	2	0	0	0	0	0	2	100.0	0	0.0	100.0
2		1	2	0	0	0	0	0	2	85.0	3	5.0	90.0
3		1	1	0	0	0	0	0	1	45.0	2	45.0	90.0
4		2	2	0	0	0	0	0	2	100.0	0	0.0	100.0
5		1	1	0	0	0	0	0	2	97.0	0	0.0	97.0
6		1	2	3	75.0	0	0	75.0	0	0.0	0	0.0	0.0
7		1	2	1	80.0	0	0	80.0	0	0.0	0	0.0	0.0
8		2	6	0	0	0	0	0	2	85.0	3	7.0	92.0
9		2	6	0	0	0	0	0	2	80.0	3	5.0	85.0
10		2	6	0	0	0	0	0	2	90.0	3	2.5	92.5
11		1	5	2	T	0	0	0	1	87.5	0	0.0	87.5
12		3	2	0	0	0	0	0	2	95.0	0	0.0	95.0
13		1	2	0	0	0	0	0	2	50.0	1	40.0	90.0
14		1	1	0	0	0	0	0	1	95.0	0	0.0	95.0
15		1	1	0	0	0	0	0	1	95.0	3	0.0	95.0
16		1	1	0	0	0	0	0	2	100.0	0	0.0	100.0
17		2	1	0	0	0	0	0	2	100.0	0	0.0	100.0
18		2	2	0	0	0	0	0	2	95.0	0	0.0	95.0
19		2	2	0	0	0	0	0	2	100.0	3	0.0	100.0
20		2	2	0	0	0	0	0	2	100.0	0	0.0	100.0
21		2	2	0	0	0	0	0	2	30.0	1	70.0	100.0
22		1	2	0	0	0	0	0	2	95.0	0	0.0	95.0
23		1	2	0	0	0	0	0	2	95.0	0	0.0	95.0
24		2	2	0	0	0	0	0	2	95.0	0	0.0	95.0
25		1	2	2	T	0	0	0	2	98.0	3	1.0	99.0
26		2	2	0	0	0	0	0	5	96.5	0	0.0	96.5
27		1	2	0	0	0	0	0	2	100.0	0	0.0	100.0
28		2	2	0	0	0	0	0	2	95.0	3	1.0	96.0
29		1	2	0	0	0	0	0	2	99.0	3	0.0	99.0
30		2	1	0	0	0	0	0	2	98.0	0	0.0	98.0
31		2	2	0	0	0	0	0	1	75.0	2	24.0	99.0
32		2	1	0	0	0	0	0	2	99.0	0	0.0	99.0
33		1	3	0	0	0	0	0	1	95.0	3	5.0	100.0
34		2	2	0	0	0	0	0	1	100.0	0	0.0	100.0
35		3	2	0	0	0	0	0	2	98.0	3	2.0	100.0
36		1	2	0	0	0	0	0	2	100.0	0	0.0	100.0
37		1	2	0	0	0	0	0	2	99.0	0	0.0	99.0
38		0	0	0	0	0	0	0	2	100.0	0	0.0	100.0
39		1	2	0	0	0	0	0	2	100.0	0	0.0	100.0
40		1	1	0	0	0	0	0	2	100.0	0	0.0	100.0
41		2	2	0	0	0	0	0	2	90.0	0	0.0	90.0
42		1	2	0	0	0	0	0	2	94.0	3	1.0	95.0
43		2	7	0	0	0	0	0	2	95.0	0	0.0	95.0
44		2	1	0	0	0	0	0	2	95.0	0	0.0	95.0
45		3	1	0	0	0	0	0	2	98.0	3	0.0	98.0
46		2	2	0	0	0	0	0	2	70.0	0	0.0	70.0
47		2	1	0	0	0	0	0	2	100.0	0	0.0	100.0
48		2	1	0	0	0	0	0	2	98.0	3	0.0	98.0
49		1	3	0	0	0	0	0	2	100.0	0	0.0	100.0
50		2	2	0	0	0	0	0	2	100.0	3	0.0	100.0
51		2	2	0	0	0	0	0	1	97.5	0	0.0	97.5
52		1	1	0	0	0	0	0	2	92.5	0	0.0	92.5

LABORATORY VALUES

C_NCeCO SAM=2

OBS	LAB	METH	TRT	A1	A1P	A2	A2P	ALLP	O1	O1P	O2	O2P	OSUMP
53		2	2	6	60.0	0	0.0	60.0	0	0	0	0	0
54		1	2	7	50.0	0	0.0	50.0	0	0	0	0	0
55		1	1	1	40.0	2	15.0	55.0	1	10	0	0	10
56		2	1	4	75.0	0	0.0	75.0	0	0	0	0	0
57		1	1	1	22.5	0	0.0	22.5	0	0	0	0	0
58		1	2	1	80.0	0	0.0	80.0	0	0	0	0	0
59		1	2	3	90.0	0	0.0	90.0	0	0	0	0	0
60		2	6	4	50.0	0	0.0	50.0	0	0	0	0	0
61		2	6	4	50.0	0	0.0	50.0	0	0	0	0	0
62		2	6	4	40.0	0	0.0	40.0	0	0	0	0	0
63		1	5	1	45.0	0	0.0	45.0	0	0	0	0	0
64		3	1	4	93.0	0	0.0	93.0	0	0	0	0	0
65		1	1	1	60.0	0	0.0	60.0	0	0	0	0	0
66		1	1	4	50.0	0	0.0	50.0	0	0	0	0	0
67		1	1	4	60.0	0	0.0	60.0	0	0	0	0	0
68		1	1	1	40.0	0	0.0	40.0	0	0	0	0	0
69		2	1	1	65.0	0	0.0	65.0	0	0	0	0	0
70		2	2	4	60.0	0	0.0	60.0	0	0	0	0	0
71		2	1	4	50.0	0	0.0	50.0	0	0	0	0	0
72		2	2	4	62.5	0	0.0	62.5	0	0	0	0	0
73		3	2	4	95.0	0	0.0	95.0	1	1	0	0	1
74		3	1	4	62.5	0	0.0	62.5	0	0	0	0	0
75		1	2	4	40.0	0	0.0	40.0	0	0	0	0	0
76		2	2	4	60.0	0	0.0	60.0	0	0	0	0	0
77		1	2	4	50.0	2	2.5	52.5	0	0	0	0	0
78		2	2	4	87.5	0	0.0	87.5	0	0	0	0	0
79		1	2	4	15.0	0	0.0	15.0	0	0	0	0	0
80		2	2	6	70.0	0	0.0	70.0	0	0	0	0	0
81		1	2	4	50.0	0	0.0	50.0	0	0	0	0	0
82		2	1	6	50.0	0	0.0	50.0	0	0	0	0	0
83		2	2	1	40.0	0	0.0	40.0	1	10	0	0	10
84		3	1	4	50.0	0	0.0	50.0	0	0	0	0	0
85		1	3	1	90.0	0	0.0	90.0	0	0	0	0	0
86		3	1	4	50.0	0	0.0	50.0	0	0	0	0	0
87		3	2	4	23.0	0	0.0	23.0	0	0	0	0	0
88		1	2	8	50.0	0	0.0	50.0	0	0	0	0	0
89		1	2	1	50.0	0	0.0	50.0	0	0	0	0	0
90		0	0	1	20.0	0	0.0	20.0	0	0	0	0	0
91		1	1	5	30.0	0	0.0	30.0	0	0	0	0	0
92		1	1	4	74.0	0	0.0	74.0	0	0	0	0	0
93		2	2	4	70.0	0	0.0	70.0	0	0	0	0	0
94		3	2	4	25.0	0	0.0	25.0	6	50	3	0	50
95		2	7	4	45.0	0	0.0	45.0	0	0	0	0	0
96		2	1	3	40.0	0	0.0	40.0	0	0	0	0	0
97		3	1	4	20.0	0	0.0	20.0	0	0	0	0	0
98		2	2	6	30.0	0	0.0	30.0	0	0	0	0	0
99		2	1	4	50.0	0	0.0	50.0	0	0	0	0	0
100		2	1	4	60.0	0	0.0	60.0	0	0	0	0	0
101		1	3	0	40.0	0	0.0	40.0	0	0	0	0	0
102		2	2	6	49.0	2	1.0	50.0	0	0	3	0	0
103		2	2	4	40.0	2	2.0	42.0	2	3	0	0	3
104		2	1	4	65.0	0	0.0	65.0	0	0	0	0	0

LABORATORY VALUES

C_NCoCO SAMPS

OBS	LAB	METH	TRT	A1	A1P	A2	A2P	ALLP	O1	O1P	O2	O2P	OSUMP
105		2	2	0	0	0	0	0	1	98.0	0	0	98.0
106		1	2	0	0	0	0	0	1	99.0	1	0	99.0
107		1	1	0	0	0	0	0	1	90.0	1	5	95.0
108		1	4	0	0	0	0	0	1	95.0	0	0	95.0
109		1	2	0	0	0	0	0	1	98.0	0	0	98.0
110		1	3	0	0	0	0	0	1	85.0	0	0	85.0
111		1	3	0	0	0	0	0	1	90.0	0	0	90.0
112		1	6	0	0	0	0	0	2	95.0	0	0	95.0
113		2	6	0	0	0	0	0	2	95.0	4	0	95.0
114		1	6	0	0	0	0	0	2	90.0	1	0	90.0
115		1	5	0	0	0	0	0	1	99.0	0	0	99.0
116		1	2	0	0	0	0	0	1	99.5	1	0	99.5
117		1	2	0	0	0	0	0	2	99.0	1	0	99.0
118		1	1	0	0	0	0	0	1	100.0	0	0	100.0
119		1	1	0	0	0	0	0	1	99.0	1	0	99.0
120		1	1	0	0	0	0	0	1	100.0	0	0	100.0
121		2	1	0	0	0	0	0	1	100.0	0	0	100.0
122		2	2	0	0	0	0	0	1	100.0	0	0	100.0
123		2	2	0	0	0	0	0	1	100.0	1	0	100.0
124		2	2	0	0	0	0	0	1	100.0	0	0	100.0
125		2	2	0	0	0	0	0	2	100.0	0	0	100.0
126		1	2	0	0	0	0	0	1	95.0	0	0	95.0
127		1	2	0	0	0	0	0	4	100.0	0	0	100.0
128		2	2	0	0	0	0	0	2	100.0	0	0	100.0
129		1	2	0	0	0	0	0	1	98.0	1	2	100.0
130		2	2	0	0	0	0	0	2	87.5	1	0	87.5
131		1	2	0	0	0	0	0	2	100.0	0	0	100.0
132		2	2	0	0	0	0	0	5	100.0	0	0	100.0
133		1	2	0	0	0	0	0	1	98.0	1	0	98.0
134		2	1	0	0	0	0	0	1	85.0	4	15	100.0
135		2	2	0	0	0	0	0	1	25.0	2	75	100.0
136		1	1	0	0	0	0	0	1	99.0	0	0	99.0
137		1	1	0	0	0	0	0	1	100.0	0	0	100.0
138		2	2	0	0	0	0	0	1	100.0	0	0	100.0
139		1	2	0	0	0	0	0	1	99.0	1	0	99.0
140		1	2	0	0	0	0	0	1	100.0	0	0	100.0
141		1	2	0	0	0	0	0	1	99.0	0	0	99.0
142		0	0	0	0	0	0	0	1	100.0	0	0	100.0
143		1	2	0	0	0	0	0	1	100.0	0	0	100.0
144		1	1	0	0	0	0	0	1	99.0	0	0	99.0
145		2	2	0	0	0	0	0	1	100.0	0	0	100.0
146		1	2	0	0	0	0	0	1	98.0	0	0	98.0
147		2	7	0	0	0	0	0	2	95.0	0	0	95.0
148		2	1	0	0	0	0	0	2	90.0	0	0	90.0
149		1	1	0	0	0	0	0	2	100.0	0	0	100.0
150		2	2	0	0	0	0	0	2	85.0	0	0	85.0
151		2	2	0	0	0	0	0	1	100.0	0	0	100.0
152		2	2	0	0	0	0	0	2	99.0	0	0	99.0
153		1	3	0	0	0	0	0	2	100.0	0	0	100.0
154		2	2	0	0	0	0	0	1	100.0	0	0	100.0
155		2	2	0	0	0	0	0	1	99.5	0	0	99.5
156		1	2	0	0	0	0	0	1	100.0	0	0	100.0

LABORATORY VALUES

C_NC=CO SAMPLE

OBS	LAB	METH	TRT	A1	A1P	A2	A2P	ALLP	O1	O1P	O2	O2P	OSUMP
157		2	2	2	95.0	0	0	95.0	0	0.0	0	0	0.0
158		1	2	2	90.0	0	0	90.0	0	0.0	3	0	0.0
159		1	1	2	65.0	0	0	65.0	1	15.0	0	0	15.0
160		2	1	2	95.0	0	0	95.0	0	0.0	0	0	0.0
161		1	1	2	98.0	0	0	98.0	0	0.0	0	0	0.0
162		1	2	2	90.0	0	0	90.0	0	0.0	0	0	0.0
163		1	2	2	95.0	0	0	95.0	0	0.0	0	0	0.0
164		2	6	2	75.0	0	0	75.0	1	5.0	0	0	5.0
165		2	6	2	90.0	0	0	90.0	1	2.5	0	0	2.5
166		2	6	2	70.0	0	0	70.0	1	2.5	0	0	2.5
167		1	5	2	95.0	0	0	95.0	0	0.0	0	0	0.0
168		3	1	2	93.0	0	0	93.0	0	0.0	0	0	0.0
169		1	2	2	80.0	0	0	80.0	0	0.0	0	0	0.0
170		1	1	2	95.0	0	0	95.0	0	0.0	0	0	0.0
171		1	1	2	96.0	0	0	96.0	0	0.0	0	0	0.0
172		1	1	2	80.0	0	0	80.0	0	0.0	0	0	0.0
173		2	1	2	100.0	0	0	100.0	0	0.0	0	0	0.0
174		2	2	2	95.0	0	0	95.0	0	0.0	0	0	0.0
175		2	1	2	96.0	0	0	96.0	0	0.0	4	0	0.0
176		2	2	2	99.5	0	0	99.5	0	0.0	0	0	0.0
177		2	2	2	98.0	0	0	98.0	1	2.0	0	0	2.0
178		1	1	2	80.0	0	0	80.0	0	0.0	0	0	0.0
179		1	2	2	98.0	0	0	98.0	0	0.0	0	0	0.0
180		2	2	2	95.0	0	0	95.0	0	0.0	0	0	0.0
181		1	2	2	97.5	0	0	97.5	0	0.0	0	0	0.0
182		2	2	2	82.5	0	0	82.5	0	0.0	3	0	0.0
183		1	2	2	30.0	0	0	30.0	0	0.0	0	0	0.0
184		2	2	2	95.0	0	0	95.0	0	0.0	0	0	0.0
185		1	2	2	92.5	0	0	92.5	0	0.0	0	0	0.0
186		2	1	2	85.0	0	0	85.0	3	7.5	0	0	7.5
187		2	2	2	95.0	0	0	95.0	1	1.0	2	1	2.0
188		2	1	2	99.0	0	0	99.0	0	0.0	0	0	0.0
189		1	3	2	97.0	0	0	97.0	0	0.0	0	0	0.0
190		3	1	2	30.0	0	0	30.0	1	10.0	0	0	10.0
191		3	2	2	80.0	0	0	80.0	0	0.0	0	0	0.0
192		1	2	2	90.0	0	0	90.0	0	0.0	0	0	0.0
193		1	2	2	95.0	0	0	95.0	0	0.0	0	0	0.0
194		0	0	2	41.0	0	0	41.0	0	0.0	0	0	0.0
195		1	1	2	65.0	0	0	65.0	0	0.0	0	0	0.0
196		1	1	2	65.0	0	0	65.0	0	0.0	0	0	0.0
197		2	2	2	92.5	0	0	92.5	0	0.0	0	0	0.0
198		1	2	2	90.0	0	0	90.0	0	0.0	0	0	0.0
199		2	2	2	90.0	0	0	90.0	0	0.0	0	0	0.0
200		2	1	2	75.0	0	0	75.0	2	5.0	0	0	5.0
201		3	1	2	100.0	0	0	100.0	0	0.0	0	0	0.0
202		2	2	2	65.0	0	0	65.0	0	0.0	0	0	0.0
203		2	1	2	95.0	0	0	95.0	0	0.0	0	0	0.0
204		2	1	2	97.0	0	0	97.0	0	0.0	0	0	0.0
205		1	3	0	60.0	0	0	60.0	0	0.0	0	0	0.0
206		2	2	2	85.0	0	0	85.0	0	0.0	0	0	0.0
207		2	2	2	50.0	0	0	50.0	2	10.0	0	0	10.0
208		2	1	2	94.0	0	0	94.0	0	0.0	0	0	0.0

DESCRIPTIVE STATISTICS

OBS	C_NC	SAM	M_ALLP	M_USUMP	S_ALLP	S_USUMP	N_ALLP	N_USUMP
1	CO	1	0.0000	96.1100	0.0000	5.3674	50	50
2	CO	2	52.9712	1.4231	19.2838	7.1465	52	52
3	CO	3	0.0000	97.6827	0.0000	3.9668	52	52
4	CO	4	84.5481	1.1827	17.4410	3.0647	52	52